UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER RESOURCES PROGRAMS OF THE U.S. GEOLOGICAL SURVEY RELATED TO AGRICULTURE IN LOUISIANA

By Thomas L. Huntzinger

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UNITED STATES DEPARTMENT OF THE INTERIOR

JAMES G. WATT, Secretary

GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information
write to:

District Chief
U.S. Geological Survey, WRD
P.O. Box 66492
Baton Rouge, LA 70896
(504) 389-0281

For sale by:

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ABSTRACT

The U.S. Geological Survey, an agency within the Department of Interior, has been an integral part of the water-resources community since 1879. The Water Resources Division is the largest division in terms of employees and size of program and is divided into four regions (northeastern, southeastern, central and western). Each region is composed of districts that correspond, with a few exceptions, to state boundaries.

Louisiana District programs fall into one of three funding categories: (1) the Federal-State cooperative program, (2) projects done for other Federal agencies, and (3) Survey-mandated programs. Funding is divided between surveillance activities and interpretive studies.

Surveillance activities include long-term, hydrologic-data-collection sites that serve a current-purpose, management function and (or) that furnish a data base for interpretive studies. A network of data sites is maintained statewide, providing data on stage and discharge of streams, ground-water levels, and surface- and ground-water quality.

Interpretive studies have objectives that are oriented toward a particular geographic area, to a particular set of hydrologic phenomena, or to obtain information for use in solving specific problems. Current studies of interest to agriculture include the following: (1) Flood hydraulics and hydrology, (2) Low-flow or base-flow of streams in Louisiana, (3) Hydrologic studies in southwestern Louisiana, (4) Hydrologic impacts of surface mining in nothern Louisiana, (5) Sparta aquifer study, and (6) Limnology of freshwater lakes.

INTRODUCTION

The U.S. Geological Survey has been an integral part of the Water Resources community since 1879, when Congress passed the organic act and defined our mission. In the more than 100 years of service to the Nation, the Survey has distinguished itself worldwide for surveillance, scientific interpretation, and research in the environmental

sciences. Geological Survey programs seek to serve all levels of environmental interests, from local agricultural communities to foreign nations.

Our mission is somewhat unique in a federal agency, because we have no regulatory or enforcement functions. The U.S. Geological Survey was established as a non-partisan, objective, fact-finding agency to which the public and government could turn for reliable and unbiased environmental information. Therefore, the Geological Survey is willing to assess and compare the effects of man's activities on the environment but will not select or recommend management alternatives.

General Agency Characteristics

The U.S. Geological Survey is an agency within the Department of Interior with national headquarters in Reston, Va. The Water Resources Division is the largest division of the Survey in terms of employees and size of program; it employs over 2,000 scientists and technicians and had a budget of about 200-million dollars for 1981. The Division has administrative, operations, and research groups at nearly all levels of the organization and is divided into four regions (Northeastern, Southeastern, Central and Western) as shown in figure 1. Each region is composed of districts that correspond, with a few exceptions, to state boundaries.

All Survey programs fall into one of three categories, based primarily on the funding source (fig. 2). These funding sources are any officially recognized governmental organization such as a group of local farmers or businessmen, or a local, state or federal agency. The Survey is obligated to serve all these interests, within certain policy guidelines, to the limit of its resources.

The program that serves state and local organizations is one of the strongest parts of the Water Resources Division and one of which we are most proud. It is termed the Federal-State Cooperative Program and it establishes a true partnership for water-resource studies between state and local organizations (Gilbert and Buchanan, 1981). Authorization for establishing this partnership is a one-page, joint-funding agreement, which is accompanied by a project proposal or work plan that states the specific objectives that are mutually agreed upon. There are a few general stipulations that provide guidelines for these cooperative agreements: (1) The funding is shared jointly, but the Survey can contribute no more than fifty percent of the project cost; (2) Total contributions to all cooperative agreements cannot exceed the Congressional appropriation specifically designated for this program; (3) Project work is initiated only when the objectives are mutually advantageous, and both parties are proponents of the work; (4) Projects are thoroughly evaluated to assure they are not duplicating others, are technically sound, and do not infringe significantly upon the private sector. In all cases the Geological Survey performs the project tasks, but the cooperating agency may contribute some services as credit toward their share of the funding.

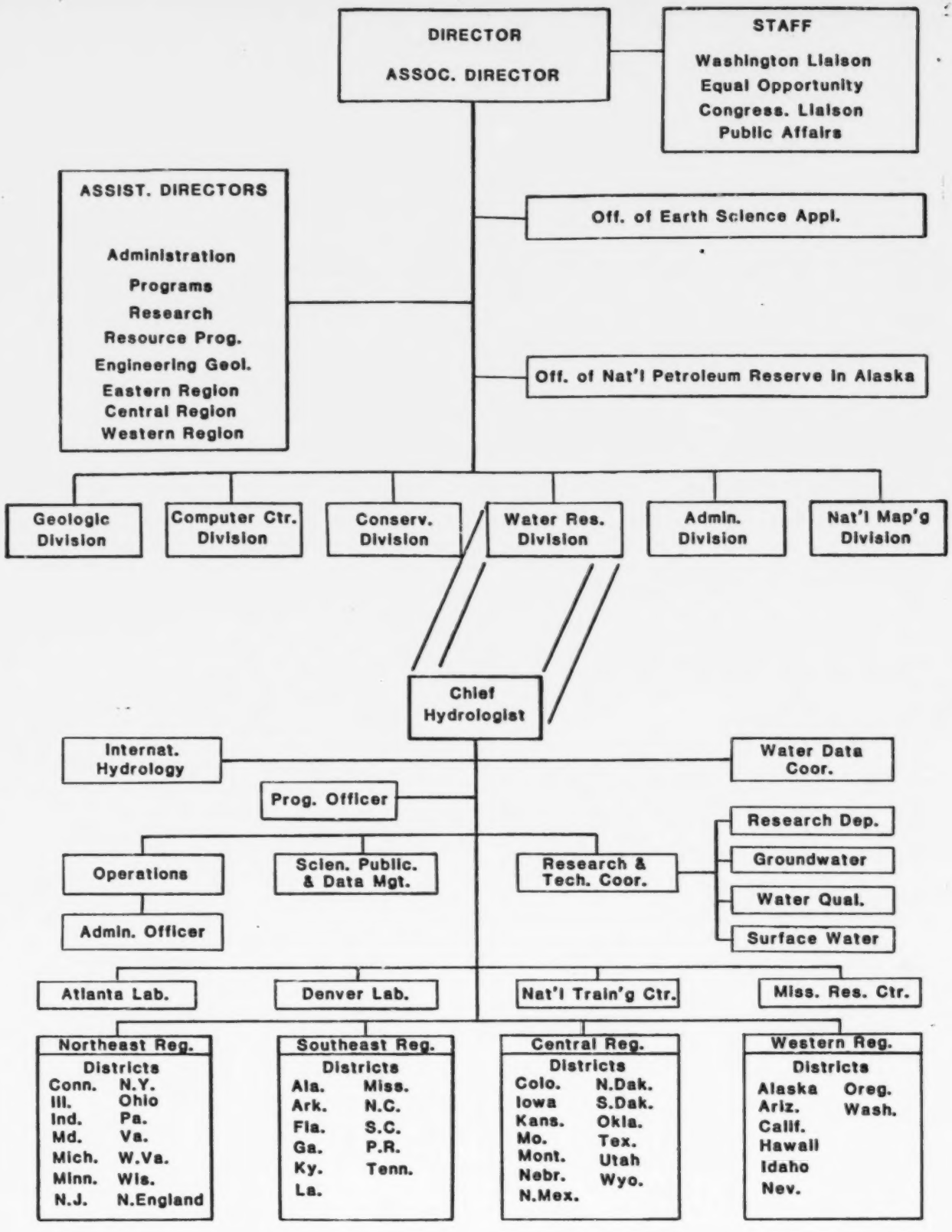


Figure 1.--U.S. Geological Survey organization.

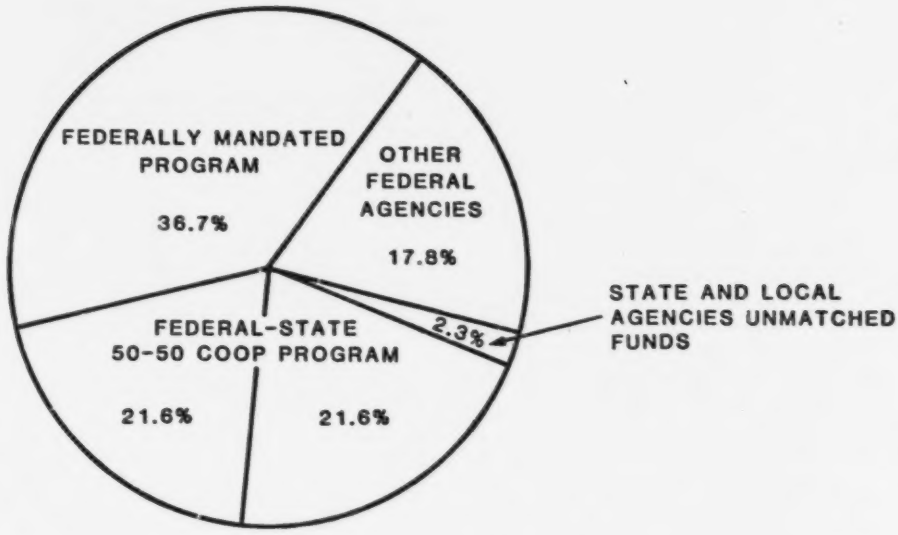


Figure 2.--Water Resources Division program.

The other two program categories are projects done for other federal agencies and those objectives that the Survey is mandated to accomplish. Other federal agencies contribute all funds for the Survey's work on their programs. Mandated programs are funded from headquarters through direct appropriations.

Current Louisiana District Program

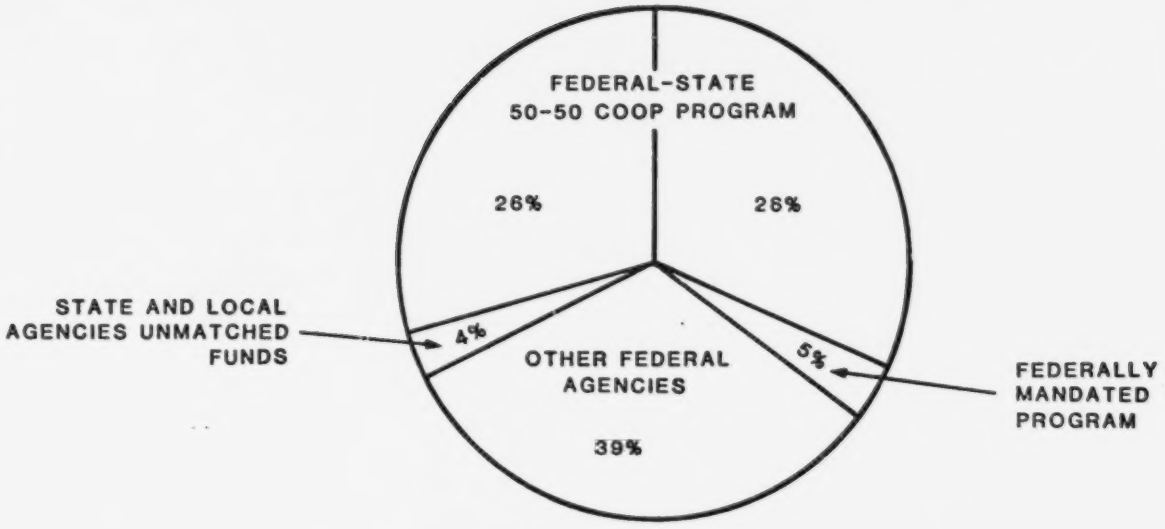
Louisiana is a district within the Southeastern Region, which is headquartered in Atlanta, Georgia. The Louisiana District office is in Baton Rouge, with a Subdistrict office in Alexandria and field offices in Lake Charles and Jonesboro (the latter soon to move to Ruston). The Louisiana District has a program that is second in size only to Florida in the southeastern region. The planned program for 1981 is about 3.6 million dollars, and the funding sources are distributed as shown in figure 3. Funding is divided between surveillance activities and interpretative studies, based on annual negotiations with each cooperator. Program operations are conducted from the District office in Baton Rouge, the Subdistrict office, and the field offices.

Surveillance and Current-Purpose Network

Surveillance activities include long-term, hydrologic-data-collection sites that serve a current-purpose, management function and (or) that furnish a data base for interpretative studies. The proposed program for 1982 includes a network of 69 surface-water data sites (continuous gaging stations), 250 flood-data sites (crest-stage stations), 679 ground-water wells (water-level observation and water-quality monitor wells), and 138 water-quality sites. The geographic distribution of the data sites is shown in figure 4.

Continuous surface-water sites are those stream locations where instrumentation is installed to record water-surface elevation (stage) on a fifteen minute interval. Discharge measurements are made periodically at the site to establish a stage-discharge relationship, which is used to compute discharge from the stage record. Mean-daily discharges are published annually for these sites (U.S. Geological Survey, "Water Resources Data for Louisiana" [released annually, 1963-80]).

A network of partial record sites is also maintained to monitor specific flows. Peak stages (crest stage) are only recorded at sites where flood information is of interest. At other sites, only the low-flow or base-flow recession is obtained for use in determining relations between ground water and surface water, to assess water supply, and for effluent studies.



TOTAL LOUISIANA DISTRICT PROGRAM, 1981: $3.6 MILLION

Figure 3.--Distribution of Louisiana District program.

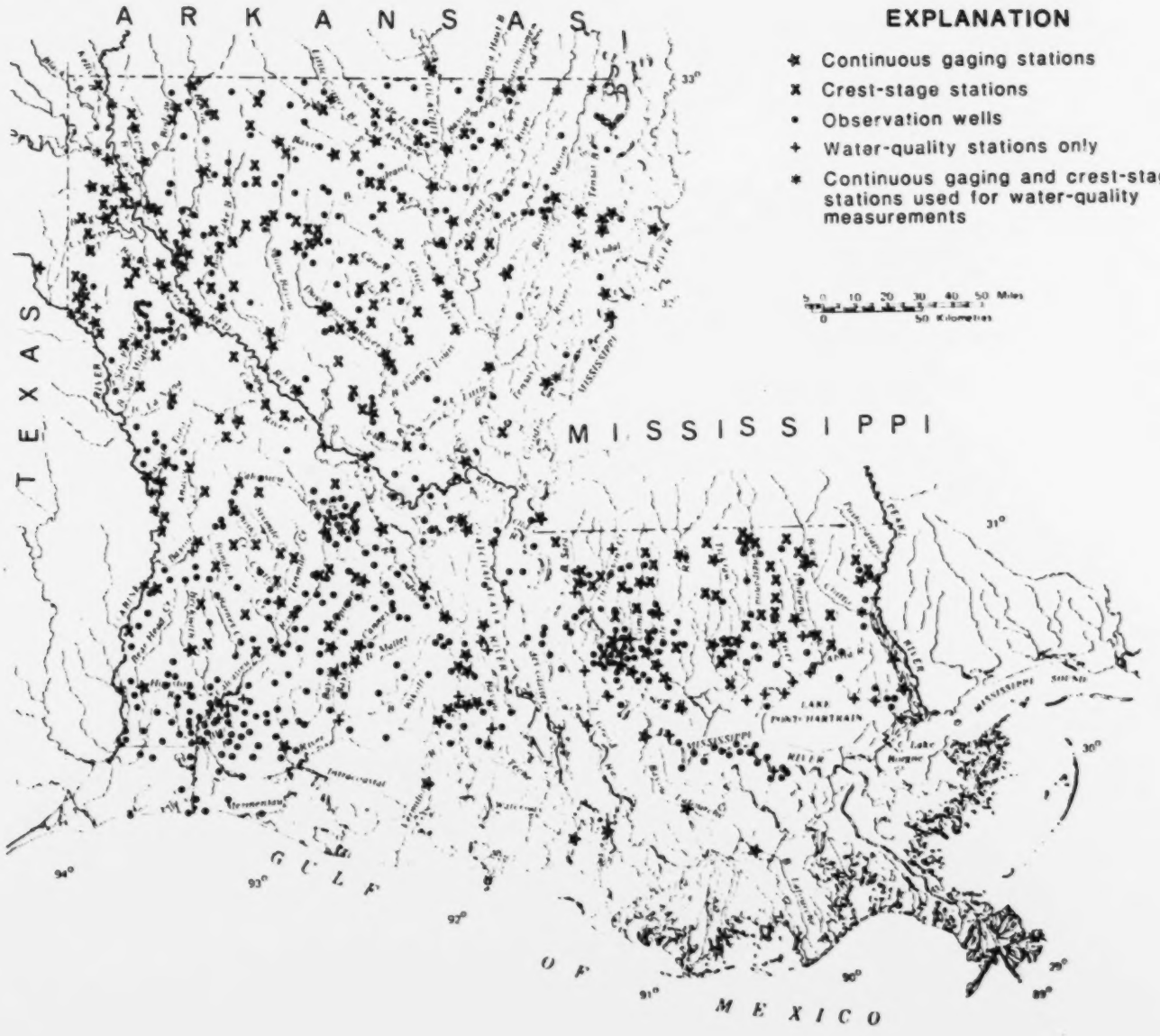


Figure 4.--Location of data sites.

The network of observation wells is maintained to monitor ground-water levels and to determine the elevation of the potentiometric surface of aquifers throughout the state. Most of the data is obtained at monthly intervals, but some data are obtained quarterly, semi-annually, annually, and biennially. The network of wells is designed to monitor all of the significant aquifers used for water supply in the State. An extensive file of miscellaneous data for the above monitor wells and many other wells that are not regularly monitored is maintained. This file contains well logs, information on well construction, and other pertinent information, which is used to determine aquifer properties for interpretive studies and for public information.

A major part of the surveillance effort is directed to water-quality monitoring. Approximately 50 percent of our surface-water sites are also sites where water-quality data are collected. The type of water analysis and the frequency of data collection varies widely, depending on specific program objectives and cooperator needs. The general types of water-quality analyses that may be done for a data site are listed below:

Common inorganic constituents (cations and anions)
Nutrients (phosphorus and nitrogen compounds)
Organics (total organic carbon, oil and grease)
Pesticides (herbicides and insecticides)
Trace elements (heavy metals or transition metals)
Sediment
Field parameters
    Specific conductance
    Temperature
    pH
    Dissolved oxygen

Water-quality samples for stream sites are generally collected once monthly or less frequently.

Similar water-quality programs exist for ground water. However, in general, sampling is less frequent and the types of analyses may be less complete than the analyses for surface-water samples.

Water Use

A basic need in many hydrologic studies is information on water use. The Geological Survey has a program with the Louisiana Office of Public Works to collect and compile water-use data. The information has been collected every 5 years for many years, but in 1980 a program was initiated which included plans for monitoring a more-or-less current data base.

The water-use program involves documenting the use of ground and surface water for agriculture, industry, public supplies, and rural use (table 1, fig. 5). Data is obtained by a complex system of questionnaires, phone calls, well monitors, and personal interviews

Table 1.--Total pumpage by principal use and source, 1950-75

[In millions of gallons per day]

Year		Public supply	Industrial	Thermoelectric	Rural	Irrigation	Total
1950	Ground water----	55	340	(b)	40	400	835
	Surface water---	95	1,600	(b)	7	590	2,292
	Total-----	150	1,940	(b)	47	990	3,127
1955	Ground water----	83	480	(b)	22	380	965
	Surface water---	160	3,200	(b)	17	830	4,207
	Total-----	243	3,680	(b)	39	1,210	5,172
1960	Ground water----	93	381	(b)	53	594	1,121
	Surface water---	174	3,705	(b)	16	773	4,668
	Total-----	267	4,086	(b)	69	1,367	5,789
1965	Ground water----	121	387	27	58	580	1,173
	Surface water---	237	2,236	2,218	11	829	5,531
	Total-----	358	2,623	2,245	69	1,409	6,704
1970	Ground water----	141	496	36	78	774	1,525
	Surface water---	243	3,657	2,847	11	783	7,541
	Total-----	384	4,153	2,883	89	1,557	9,066
1975	Ground water----	201	471	31	52	807	1,563
	Surface water---	300	3,277	5,445	9	1,136	10,167
	Total-----	501	3,748	5,476	61	1,943	11,730

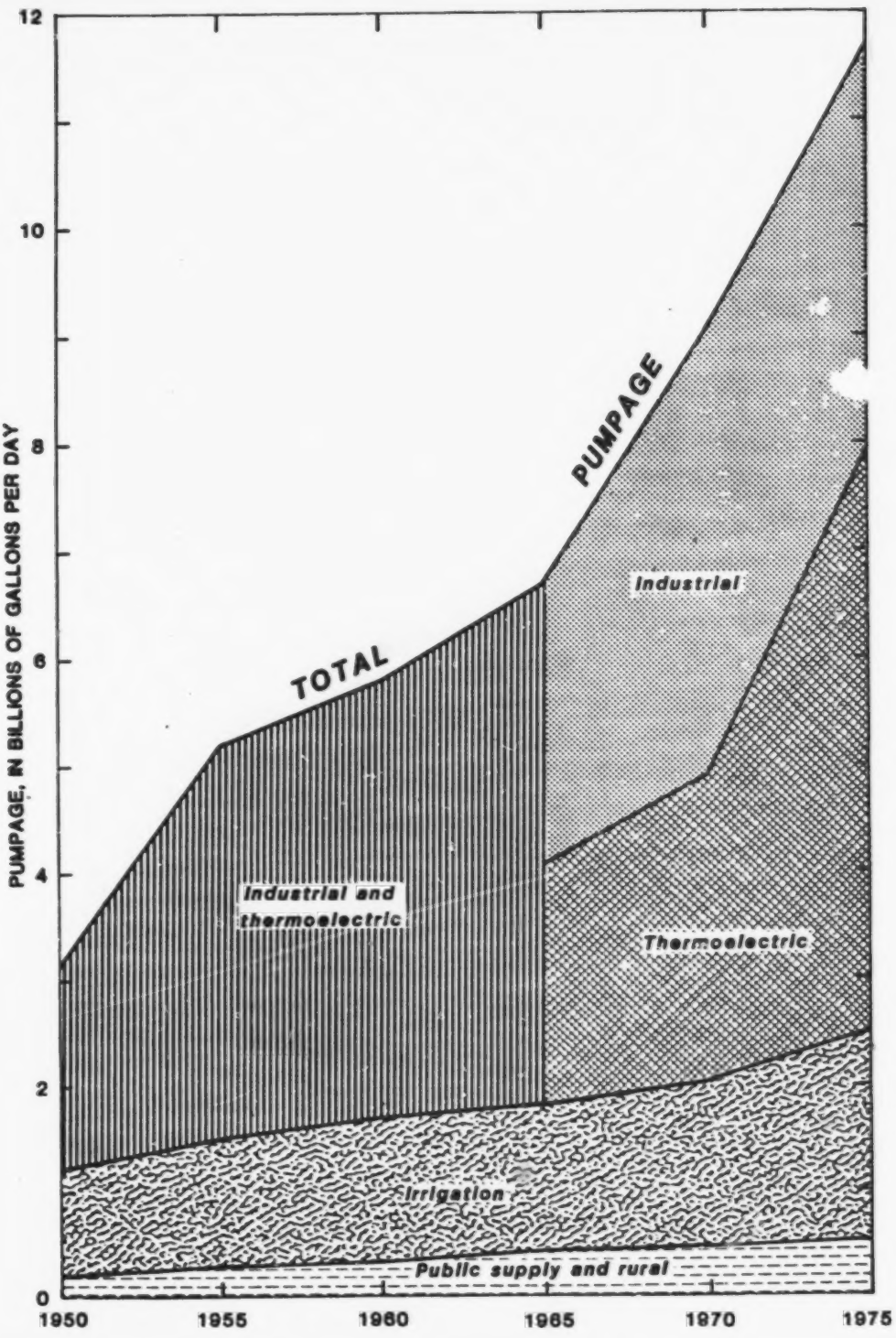


Figure 5.--Pumpage in Louisiana by categories, 1950-75.

through which information contacts have been established over the years. Data obtained from this effort is compiled by parish, river basin, and source.

Data from this program is used specifically by the U.S. Geological Survey to analyze aquifer response to pumping stress and to evaluate causes of problems in ground-water quality and supply. Also, both areal and time distribution of pumping are primary inputs to ground-water models, which are used in ground-water management.

Interpretive Studies

The U.S. Geological Survey has a primary responsibility to interpret and evaluate the data it collects and, conversely, to collect data specifically to aid in the interpretation of hydrologic phenomena. These activities are a part of the Interpretative Studies Section of the Louisiana District and the Subdistrict in Alexandria. Interpretative studies have objectives that are oriented toward a particular geographic area, to a particular set of hydrologic phenomena, or to obtain information for use in solving specific problems. The Louisiana District tries to utilize its limited resources to conduct studies that reflect the priorities of the State and the National priorities of the Survey.

A significant number of interpretative projects are directly or indirectly related to agriculture. A brief discussion of these projects will reflect the Louisiana District's interests in Louisiana agriculture (fig. 6).

Flood hydraulics and hydrology have been continuing priorities in Louisiana because of the low topographic relief and flat-sloped streams, which contribute to significant flooding problems. The Survey has a statewide study that was initiated to determine flood characteristics for bridge design; but many other interests have been served also, including agriculture. More than 20 years of flood-event data have been collected at over 100 small-watershed sites (fig. 4). Also, data on rainfall and the resulting runoff have been collected for many small streams in Louisiana. The interpretation of these data have resulted in flood reports that give estimates of the size of flood that can be expected on those streams where data are available. Also, methods have been developed to predict the size of floods on any watershed in the state. All analyses are based on the records that are available at the time the interpretation is made and are subject to change as additional data are obtained. Therefore, these flood-frequency reports are updated periodically to reflect the additional period of record. At this time a major effort is being made to collect flood data on streams in the coastal plain and the Mississippi River delta. Limitations on instrumentation and analysis technology have prevented collection of adequate data on floods in these areas in the past.

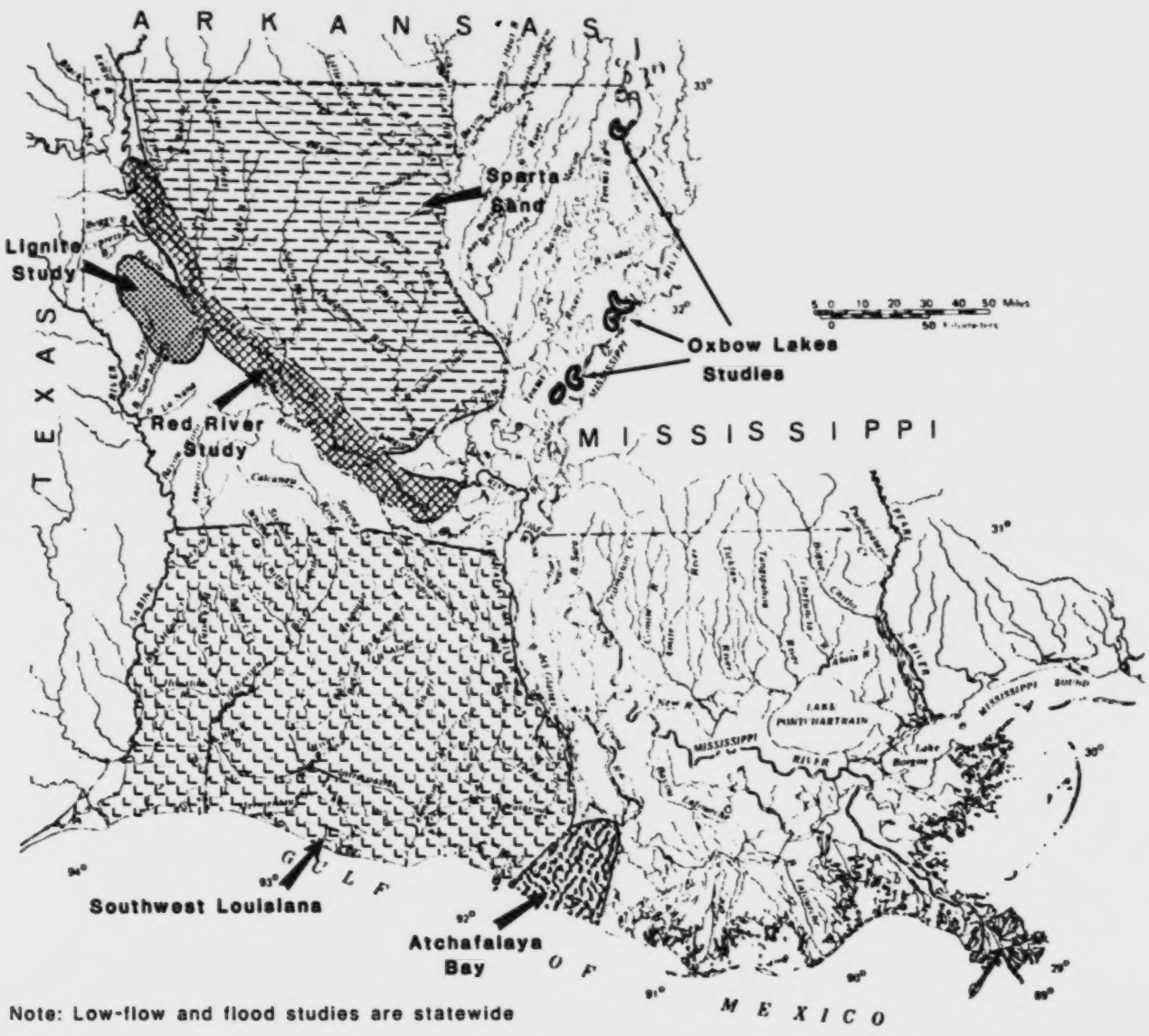


Figure 6.--Location of project activities impacting agriculture.

In addition to generalized studies of flooding, the Survey is interested in information at specific sites. Therefore, the Survey is responsible for documentation and analysis of large historic flood events that occur at specific locations in the State. If the flood event is of significant magnitude and geographic extent, a flood report is prepared for the event.

Low-flows or base flows are another area of interest in Louisiana. The minimum amount of sustained flow that can be expected for a stream is important in evaluating water supply for agriculture, industry, and public-supply use. These base flows may also reflect the sensitivity of an area to water-quality degradation from natural or induced pollution. The Louisiana District has a project that utilizes low-flow data collected in the past to predict minimum flows. A report has been published that gives estimates of low flows that can be expected at sites where sufficient data have been collected. We are currently working on a report that documents a technique for estimating low flows on streams in the State for which low-flow data are not available. A major effort is being made to collect low-flow data in the coastal plain and Mississippi River delta. The same restrictions on instrumentation and analysis that pertain to flood data have limited work on low flows.

Hydrologic studies in southwestern Louisiana have always been given a high priority because of the area's economic dependency on water. Most of the work has been related to ground water because of the extensive use of that resource. A report on salinity of ground water, addressing both encroachment in the coastal area and vertical migration of saltwater is in preparation. A general study of ground-water quality has been completed and work on a report to present the findings has begun. A ground-water model of the Chicot aquifer is in the final planning stages, and data compilation has been started. Modeling results will define the effects of pumping on the aquifer and enable prediction of future changes in pumping. The Survey has been working closely with Louisiana State University in developing remote-sensing techniques to differentiate between surface- and ground-water irrigation of rice, using satellite photography. It is planned that the data will be used to provide pumping-distribution data for ground-water modeling and water-budget studies of streams.

A relatively current emphasis has been on hydrologic studies of the oxbow lakes along the Mississippi River, which provide recreational and commercial fishing as well as local water supply. The watersheds that contribute to most of these lakes are agricultural land, and the lake levels are responsive to the stage of the Mississippi River. Our objective is to determine the natural aging processes, effects (if any) of agricultural activities, and contributions from the Mississippi River; because quantitative studies of the lakes in the past were very limited. The Survey is studying Lake Bruin intensively to determine its limnological characteristics. Other oxbow lakes that are monitored for general water-quality information include Lakes Providence, Concordia, St. John, and St. Joseph.

The Atchafalaya Basin is very important to Louisiana residents who depend on the agricultural, wood-product, and fishing industries in the area and to those who use it for recreation. Nature has selected the Atchafalaya River as the most direct route for the Mississippi River to reach the Gulf, but man has restricted it with levees and control structures. However, the Atchafalaya River and its basin is used for flood relief when needed to protect development on the Lower Mississippi River, thus increasing the flows and sediment loads to the Atchafalaya Basin. Extremely high flood releases from the Mississippi River, specifically in 1973 and 1975, have initiated environmental changes and land accretion in the Atchalafaya Basin and in the Atchafalaya Bay. The Geological Survey has studied the Atchafalaya River in the past and is currently collecting data in the Lower Atchafalaya River below Morgan City and in the Bay near the river mouth. The Survey is specifically interested in the sedimentation loads and land accretion rates in the Atchafalaya Bay.

In northwestern Louisiana, areas in DeSoto, Red River, and Bienville Parishes have significant amounts of useable lignite (a soft coal). This energy resource is extracted by surface-mining procedures involving disturbance of as much as 200 feet of overburden. Potential impacts on hydrology and traditional agricultural activities is very great when large earth-moving activities, such as these, occur in an area. The Survey is determining the baseline hydrologic conditions that exist in DeSoto Parish before mining begins. Ground-water in the DeSoto Parish area is obtained from relatively shallow sands, which will be disturbed by the mining activity. Also, steep, sandy terrain, now in forest and pastureland, is subject to erosion and production of sediment when disturbed. Problems related to ground-water supply, revegetation, and erosion control must be addressed when mining begins in DeSoto Parish.

Mining activities are planned also in Red River Parish where the lignite underlies the Red River alluvium. Most of this land is presently cultivated and will be disturbed by displacement of up to 80 feet of overburden. Potential problems of surface flooding and ground-water stresses during the mining operation must be addressed. Survey information will provide baseline data that will be useful to those who are responsible for returning mined areas to productive land. Lignite supplies are estimated to be sufficient to sustain mining activity for 30 years.

The Survey has been involved in another project in the Red River Valley related to the navigation project of the Corps of Engineers (fig. 7). Proposed lock and dam construction from the confluence with the Black River to Shreveport, Louisiana, may cause significant changes in the ground-water levels adjacent to the impoundments. Predictions of the rise in ground-water levels, based on Survey studies, have been used by the U.S. Soil Conservation Service to assess the economic impacts on productive agricultural land. We are also involved with the Corps of Engineers, in evaluating the impacts of the higher water tables on urban areas.

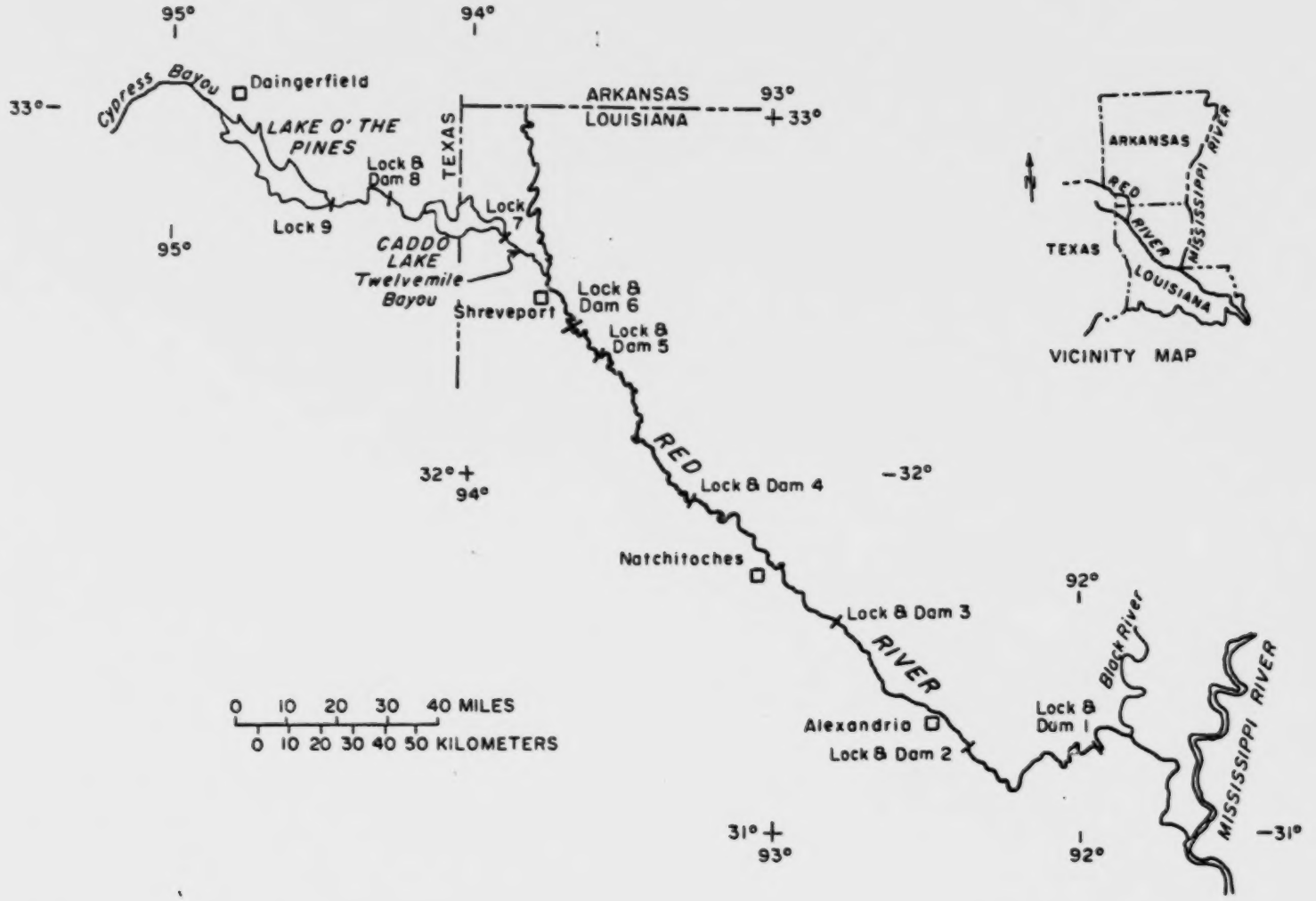


Figure 7.--Planned navigation features, Red River Waterways Project.

North-central Louisiana relies on the Sparta aquifer for water supply. The Survey is studying the characteristics of this aquifer, because heavy pumping, chiefly by the paper industry, is creating significant drawdown in the area. Also, the aquifer southeast of Monroe contains salty water, and increased usage by the Monroe urban community threatens to draw saltwater into the water supplies. Information from ground-water-model studies will be used in assessing ground-water management alternatives in northern Louisiana.

Many other studies that do not relate directly to agricultural activity should be mentioned. The Lower Mississippi River is being studied to determine the water quality and biological characteristics of the River and its distributaries from St. Francisville to the wetlands below Venice. Ground-water studies of the many aquifers underlying Baton Rouge and New Orleans involve evaluating the water supplies for these major industrial and metropolitan areas. The northern Louisiana salt domes are being studied to determine the hydrologic impacts of using them for hazardous-waste disposal.

As indicated by this discussion of interpretive studies, the Survey is very much involved in providing Louisiana's people with the information they need to solve problems and manage the State's water resources. The Survey has always tried to direct its limited resources to activities that meet the most urgent needs.

Future Directions

Activities of the U.S. Geological Survey directly reflect the priorities of those who set government policy. Therefore, the attitude of the people toward water resources, as reflected by the elected officials, determines the limits of the Survey's activity. Based on the current attitudes toward Federal activity, the Survey anticipates a major emphasis on a no-growth policy, limiting our activities to programs of highest priority. However, the Survey is committed to excellence in hydrology and will continue to maintain high-quality hydrologic surveillance and interpretation in Louisiana.

Hydrologic Surveillance

Surveillance activities will involve collection of hydrologic data necessary to evaluate Louisiana's water resources. Emphasis will be placed on data-network design and information efficiency, which will require close coordination with cooperators. Past records will be evaluated, and sites that are of minimum interest, or that provide marginal information, will be considered for termination. However, surveillance activities will be continued in all areas of major hydrologic interest in Louisiana. Data will be collected on the major rivers in the State as in the past. Flood and low-flow data sites will be maintained to provide this information for the State. An increased effort will be made to obtain stream-flow data in the coastal area and in the Mississippi River flood plain and delta where insufficient data has been obtained in the past.

Collection of water-quality data will continue throughout the State for selected sites that are compatible with network design and information efficiency concepts. Again, coastal areas and the Mississippi River will have a high priority as these areas reflect water-quality data needs and interests in Louisiana.

Ground-water levels and water quality will continue to be monitored, particularly in the major aquifers used for water supply in the State; emphasis will be on those with continued heavy use. Extensive ground-water records are available in many areas, and these records will be evaluated to ensure that an efficient network of sites is established.

Interpretative Studies

Hydrologic investigations will continue to provide accurate and objective water-resources information in Louisiana and will be continually sensitive to local needs. However, project priorities will be much more important than in the past because of the current emphasis on a no-growth funding policy. The Survey program for interpretative studies in the next few years will be directed to those areas perceived to be of major importance and interest to Louisiana.

A current nationwide emphasis is on the study of ground-water from a regional perspective. Louisiana is included in the study areas of the West Gulf Coast and Mississippi Embayment regional aquifer systems, which are now being studied. The projects will provide general information on the aquifer systems, without regard to political boundaries or local-interest limitations. The major benefit that these projects will provide to the State is information on the effects of development of local aquifer systems on the regional systems.

Southwestern Louisiana has been and is still considered to be of major interest because of the dependency of agriculture and industry on water. Studies in this area will be directed more strongly to quantitative interpretation than in the past. Ground-water modeling will be a major emphasis in the near future. Surface-water hydrology will be the next step, following the ground-water modeling effort, to provide information needed in determining the interactions between ground-water and surface-water systems. It is the Survey's objective to provide sufficient information about the hydrologic consequences of management alternatives for the people in the area to make knowledgeable decisions.

Coastal areas are an important part of Louisiana's heritage and the water resources of the area will continue to be of major interest to the State. The Louisiana District will become much more involved in coastal studies in the future. Several interpretative studies have recently been initiated to study the flow characteristics of coastal streams and estuaries.

The Survey will also concentrate on studies of other "flat slope" areas in addition to the coast. This would be primarily the Mississippi River flood plain and delta areas, extending into northern Louisiana. The hydrology in these areas has been somewhat neglected in the past because of the complexity of the hydrologic system.

Louisiana has the distinct privilege of having the lower reaches of the largest river in the nation within its boundaries. The hydrology of the Mississippi River system should not be ignored and the Survey is aware of its importance. Therefore, the Louisiana District will continue to regard studies of the Mississippi River as a high priority. Quantitative interpretation of flow and sediment characteristics will be future objectives. Also, studies of oxbow-lake, distributary, and estuarine environments will be continued.

The hydrologic consequences of hazardous-waste disposal is becoming more and more evident nationwide. Louisiana has a very dominant industrial economy and the corresponding need for proper waste disposal. The Louisiana District feels that more information on waste disposal and its potential impact on water resources is urgently needed. Industrial designers who are provided adequate and accurate hydrologic information can avoid degradation of water supplies in the future.

The impacts of urban development on water resources is another area of hydrology that is becoming very important. Studies of the effects of urbanization on rainfall and runoff will be initiated in the near future. The Survey's objectives will be to provide urban planners and residents hydrologic information needed to evaluate urban-management alternatives related to urban runoff and water quality. These urban studies would, by necessity, also include studies of the quality of rainfall (acid rainfall), another recently documented problem in some areas of the nation.

CONCLUSIONS

The U.S. Geological Survey has always played a major role in the technical and information aspects of water resources. Continued committments to maintaining high-technical standards and sensitivity to hydrologic needs will ensure the Survey's leadership in solving water-resources problems. The Louisiana District of the Survey will continue to assist the citizens of Louisiana in meeting their needs in utilizing and managing their water resources.

Agriculture and water are both at the very roots of Louisiana's economy. Therefore, the U.S. Geological Survey has always had an intense interest and involvement in Louisiana agriculture and looks forward to continuing its interest in the future.

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